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**Automated solutions: Engineering teams present capstone prototypes to industry sponsors**

**Students quadruple production of sustainable coffee cups for eco-friendly startup; deliver toys to local children**

Written by ​Abbey Goers, University of Wisconsin–Stout

Disposable coffee cups, the kind used at most cafes and take-out shops, pose a major sustainability issue. More than 40 billion are tossed in the waste each year in the U.S. alone. Whether they’re made from polystyrene or paper lined with plastic, disposable coffee cups generally aren’t recyclable, and they take decades to centuries to break down in landfills while producing methane and leaching microplastics into the environment.

A startup company in San Francisco, [GaeaStar](https://gaeastar.com/" \o "(opens in a new window)" \t "_blank), is working to solve the problem. It’s making eco-friendly disposable coffee cups out of clay, with a liquid-proof glaze. When the coffee is gone, the thin cups can be reused or tossed in the trash. Their composition makes them easily decomposable.

To ramp up its production, GaeaStar turned to students in UW-Stout’s Robert F. Cervenka School of Engineering.

A team in the Senior Design Experience capstone class developed from scratch a new machine to significantly speed up the company’s cup glazing process – quadrupling its daily output.

The team’s GaeaStar-Cup Glazing Prototype completes a semiautomated fountain glaze application, creating a consistent coating with no residue on the external cup surface. After starting the project during the spring semester, they delivered a prototype on Dec. 18 in a presentation to GaeaStar officials, professors and fellow students.

The project was one of 24 presented as part of the fall semester capstone courses – with more than 120 students working in teams in various stages of development in the [manufacturing](https://www.uwstout.edu/programs/bs-manufacturing-engineering), [mechanical](https://www.uwstout.edu/programs/bs-mechanical-engineering) and [computer and electrical](https://www.uwstout.edu/programs/bs-computer-electrical-engineering) engineering labs in Fryklund Hall.

**A sustainable solution to single-use cups**

Last spring, at the start of their capstone course, the team of five students spent months studying the glazing process, coming up with one prototype and then switching gears to another.

In mid-October, after ordering parts, the team began building their machine.

Morgan Young, of Eden Prairie, Minn., majoring in manufacturing engineering, enjoyed the real-world challenge. “GaeaStar had trust in us that we could do this, and we are overwhelmed with what we’re delivering to them,” she said.

With a larger capacity loading system, the team’s machine can glaze 10 cups per minute — GaeaStar’s current manual system can do only one.

The cups are stacked upside down on a turntable as the solution in a reservoir below pumps the glaze and sprays the interior surface of the cups. Extra glaze drips back into the reservoir, and the turntable rotates for the next cup-glazing.

The enclosed machine also includes safety features to prevent operator injury.

“A big part of it was all the testing we did. The company official realized that we were trying to understand the process before we began to build,” said Noah Pearson-Cater, of Minneapolis, majoring in manufacturing engineering. “We’re really proud to give GaeaStar a prototype that they can retune to even better fit their needs.”

Team members also included Wayne LaVine, of Northfield, Minn., manufacturing engineering; Cade Parker, of Menasha, mechanical engineering; and Grace Thoreson, of Luck, double majoring in mechanical and manufacturing engineering.

“It was a pleasure working with the team. I am very much looking forward to receiving the prototype. It will be invaluable for developing our production process,” said GaeaStar Mechanical Design Engineer Harrison Lin.

Eventually, GaeaStar would like to sell machines to coffee shops that could 3D print the clay cups and glaze them on site.

**Bringing toys to local children**

Other capstone project challenges completed in December, all involving automation of processes, were for Antigo Zeon Wire, Colder Product Company Manufacturing, Mantle, ProMed Molded Products, nVent, Rassbach Museum of Menomonie and St. Croix Tactical Manufacturing.

Sponsoring companies, many of them regional manufacturers, provide full financial support of all needed equipment and materials for the testing of ideas and build of final products or systems.

Another automation project – a three-year, cross-disciplinary, multi-course toy manufacturing project – is supported by the [G.A. Taft Manufacturing Engineering Endowed Professorship](https://www.uwstout.edu/academics/colleges-schools/college-science-technology-engineering-mathematics-management/professorships) through the School of Engineering, [awarded in fall 2023](https://www.uwstout.edu/about-us/news-center/professors-advance-research-sustainability-art-regional-water-issues-trauma-writing) to Assistant Professor Kevin Dietsche.

The project began in Dietsche’s Design for Industry class in fall 2023, when his students invited first-graders from St. Paul’s School of Menomonie to brainstorm their dream toys. The collaboration’s end goal was for the students to [build mid- to high-fidelity prototypes](https://www.uwstout.edu/about-us/news-center/uw-stout-students-team-local-children-design-toys-give-city-ash-trees-new-life) of the imagined toys using ash tree lumber provided by the City of Menomonie’s Urban Forestry Board. The final product of the toy design could be delivered to local children.

One of the prototypes – a two-wheeled duck pull-toy - was given to an engineering capstone team last spring to develop a manufacturing cell that would automatically assemble and produce the toys.

Earlier this fall, the team presented its Taft Prof Two-Wheel Toy Assembly System [manufacturing cell prototype](https://www.uwstout.edu/about-us/news-center/design-industry-students-create-kindergartners-ideal-toys-through-ai-rapid-prototyping) – constructed of wooden dowels and cardboard – to kindergartners visiting Dietsche’s class. Together, the children and the engineering team built a version of Timothy the Duck, showing them how it automatically assembles the pieces of the duck, including its body, wings, wheels and axle.

The team of four mechanical engineering seniors Grace Goodreid, of Cushing, Josh Goodreid, of Beldenville, Deric McConnell, of Luck, and Ayden Veness, of Prescott; and two computer and electrical engineering seniors Vinny Bonofiglio, of Helenville, and Shane Schauss, of Eau Claire, estimates it spent 2,600 hours completing their automatic assembly system.

On Dec. 18, they presented their system to faculty, peers, industry partners, family and community members. The machine is fully enclosed with safety features and can produce 10 toys at a time, taking about two and a half minutes to assemble one duck, allowing the operator to pause assembly and talk about the process.

The three-part portable manufacturing cell can be assembled and disassembled in minutes for ease of transport, which will allow Dietsche in the future to transport the machine to area schools and demonstrate the process of making wooden toys to local children.

The engineering capstone classes are led by Assistant Professor Danny Bee; Assistant Professor Nathan Spike, B.S. mechanical engineering program director; Senior Lecturer Glenn Bushendorf; and Instrumentation Coordinator-Instructor Paul Craig, B.S. and M.S. manufacturing program director.

Students use the stage gate-driven design and project build methodology, which includes built-in reviews throughout the process.

After their final presentations, students also submit their project documents to the companies for potential integration into manufacturing operations use or continued development.

Students build technical and communication skills in their capstones, as well as confidence as they prepare to begin their careers. The Senior Design Experience blends all three of the university’s polytechnic tenets — applied learning and research, business and industry collaboration, and career-focused experiences.

Projects finishing in spring 2025 include company sponsorships by Cirrus Aircraft, Industrial Heat Transfer, Nordson EDI and RealityWorks.

Additional corporations sponsoring student work in previous semesters included [Viracon](https://www.viracon.com/), [Fastenal](https://www.fastenal.com/), [DiaSorin](https://int.diasorin.com/en), [Industrial Heat Transfer](https://iht-inc.com/), [Loos Machine and Automation](https://loosmachine.com/) and [Graco](https://www.graco.com/us/en.html). Several companies sponsored more than one project.

Graduates from the mechanical and manufacturing engineering programs in 2022-23 reported 100% employment and an average starting salary of more than $70,000, according to the latest university [First Destination Report](https://www.uwstout.edu/academics/career-services/career-outcomes).

UW-Stout’s [Robert F. Cervenka School of Engineering](https://www.uwstout.edu/academics/colleges-schools/college-science-technology-engineering-mathematics-and-management/robert-f-cervenka-school-engineering) is home to five ABET-accredited programs that also include computer and electrical engineering, engineering technology and plastics engineering, as well as a sixth bachelor’s’ program in packaging. A master’s in manufacturing engineering is available [on campus](https://www.uwstout.edu/programs/ms-manufacturing-engineering) or [online](https://www.uwstout.edu/programs/ms-manufacturing-engineering-online).